Amendments to the Drawings

In the attached replacement drawing sheets, the shadings are deleted in order to improve reproducibility of the drawings. Also, in sheet 1, Fig. 1, the following changes are made:

Reference numeral 8 is added on the left. This reference numeral was present in the PCT drawings, but was inadvertently omitted from the drawings file 12/21/05.

One of the two reference numerals 15 is deleted at the bottom, together with the corresponding lead line.

REMARKS

1. Claim 1 was rejected under 35 U.S.C. 102(b) over Merrill, US PGPub 2002/0058353.

Claim 1 is amended to improve grammar. The amendments are unrelated to the rejection.

For anticipation under 35 U.S.C. 102, "the reference must teach every aspect of the claimed invention" (MPEP 706.02).

Claim 1 recites "a first region ... which is divided into the first, second and third portions by the regions of silicon dioxide". The examiner states that "Fig. 2 and 3 of Merrill teaches ... a first region ... divided into the first (74), second (70) and third portions (64) by the regions of silicon dioxide (¶ 43)". This is respectfully traversed. Merrill's doped regions 74, 70, 64 overlie one another in a silicon substrate, with no silicon dioxide or any other dielectric shown between them. Merrill therefore does not teach "every aspect of the claimed invention" (MPEP 706.02).

In addition, Claim 1 recites a "third heavily-doped region ... which forms a third potential barrier for charge carriers generated in the substrate region under the third barrier". For example, the applicants' P+ region 13 (Fig. 1) forms a potential barrier for charge carriers generated in P type region below the region 13. (Claim 1 is not limited to the embodiments discussed herein.)

The examiner associates the applicants' third region with Merrill's region 60. There is no indication however that Merrill's region 60 (Fig. 3) serves as a potential barrier for charge carriers generated in the substrate below region 60 as recited in Claim 1. For example, Merrill does not teach or suggest that his region 60 is doped differently from any underlying region.

2. New Claim 2 is supported by the original Fig. 1, in which the regions 14, 15 are of type P and hence are not as heavily doped as the P+ regions 11, 12, 13.

3. New Claim 3 is supported by the original Fig. 1. The "surface area" reads on the area which overlies all the three P type regions including (i) the P type region

immediately below the region 3.2, (ii) region 14, and (iii) region 15. The first regions read on any two or more of the three P type regions. The second regions read on N+ regions such as 3.1, 3.2, 3.3. Regions R_1, R_2 can be any pair of the P type regions at consecutive depths. For example, R_1 can be the P type region immediately below 3.2, and R_2 can be 14. In this case, the "entire region which underlies the first region R_1 and overlies the first region R_2" is provided by P+ region 11. Alternatively, R_1 can be 14, and R_2 can be 15. In this case, the "entire region" is provided by P+ region 12. In either case, the "entire region ... is heavier doped" to type P than R_1, R_2 as recited in Claim 3, and the "entire region" serves as a potential barrier to charge carriers formed in R_2 when the p-n junctions are reverse-biased by the positive potential applied to regions 3.1, 3.2, 3.3 (through readout circuits A_1, A_2, A_3) and the negative potential applied to region 2.

Claim 3 is not limited to the embodiments discussed herein.

In Merrill's Fig. 3, the P type regions 72, 66, 60 are isolated from each other using n-type regions 78, 80, as described in Merrill's paragraphs 0043, 0045. Thus, in the vertical cross section of Fig. 3, the region underlying 72 and overlying 66 includes n-type region 78, and the region underlying 66 and overlying 60 includes n-type region 80. Merrill does not teach or suggest modifying his structure so that in at least one vertical cross section underlying the surface area receiving incident light, the entire region underlying 72 and overlying 66, or underlying 66 and overlying 60, would have type P but would be heavier doped to type P than any one of regions 72, 66, 60, as recited in Claim 3.

4. Claims 4-8 depend from Claim 3.

5. In Claim 9, region R reads on any one of the three P type regions of the applicants' Fig. 1 (i.e. (i) the P type region immediately below 3.2, (ii) region 14, (iii) region 15). Claim 9 is not limited to the embodiments discussed herein.

Claim 9 recites that "the semiconductor substrate immediately below an entire lower boundary of the region R has the first conductivity type but is heavier doped to the first conductivity type than the first region R".

In Merrill's Fig. 3, the semiconductor substrate immediately below the lower boundary of each P type region 72, 66 includes an n-type region 70 or 80, and hence the semiconductor substrate immediately below the entire lower boundary of region 72 or 66 does not have "the first conductivity type" as recited in Claim 9. The lower boundary of P type region 60 is not shown.

6. Claims 10-13 depend from Claim 9.

7. Each of Claims 14-17 refers to one of Claims 2-13.

8. If a fee is required for this submission, please charge the fee or any underpayment thereof, or credit any overpayment, to deposit account 50-2257.

9. Any questions regarding this case can be addressed to the undersigned at the telephone number below.

Certificate of Transmission: I hereby certify that this correspondence is being transmitted to the United States Patent and Trademark Office (USPTO) via the USPTO's electronic filing system on December 3, 2007.

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